SIRTF
Project Status

presented to Origins Subcommittee

Michael Werner
SIRTF Project Scientist, JPL
February 25, 2002

[http://sirtf.caltech.edu/SSC/]

SIRTF System Architecture and Team Members

Observatory

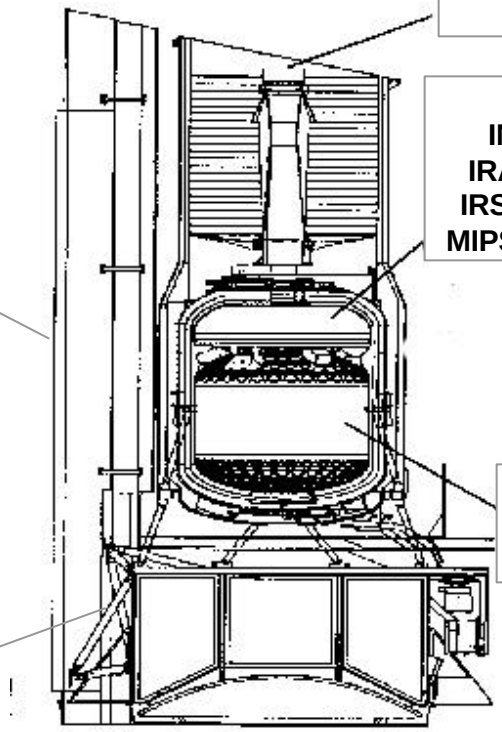
TELESCOPE (BATC)

SCIENCE INSTRUMENTS
IRAC (SAO/GSFC)
IRS (Cornell/BATC)
MIPS (U of AZ/BATC)

SOLAR PANEL
Lockheed Martin

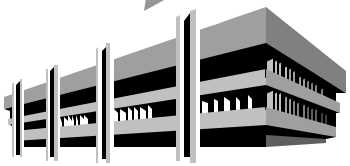
CRYOSTAT (BATC)

SPACECRAFT
Lockheed Martin



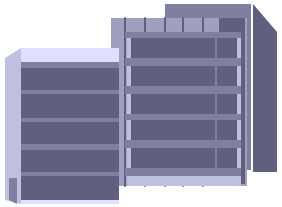
Science Community

User Community

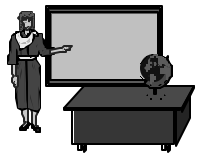


SIRTF Science Center (Caltech)

Deep Space Network

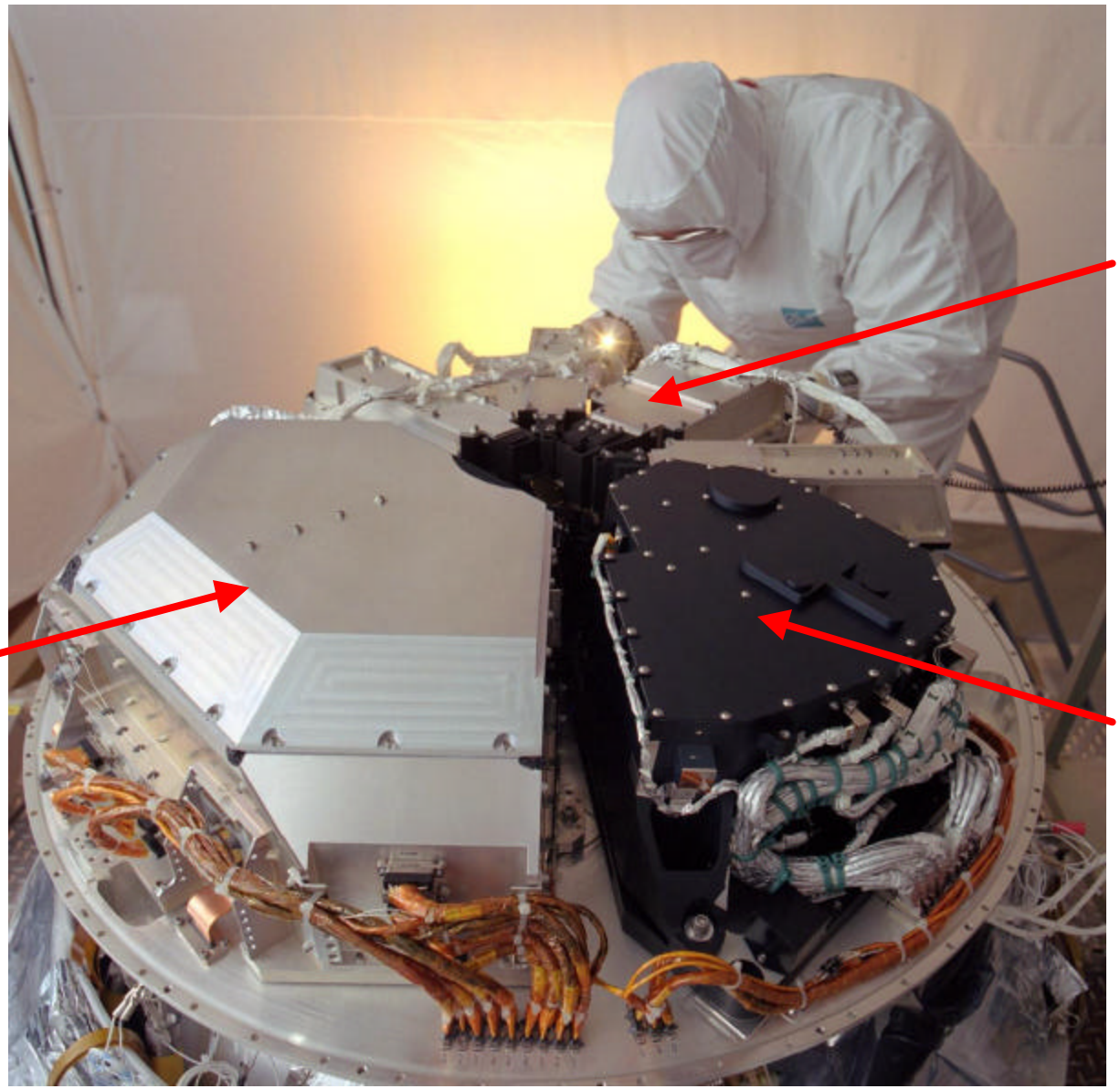


Multimission Ops. Center & Flight Operations Center (JPL)

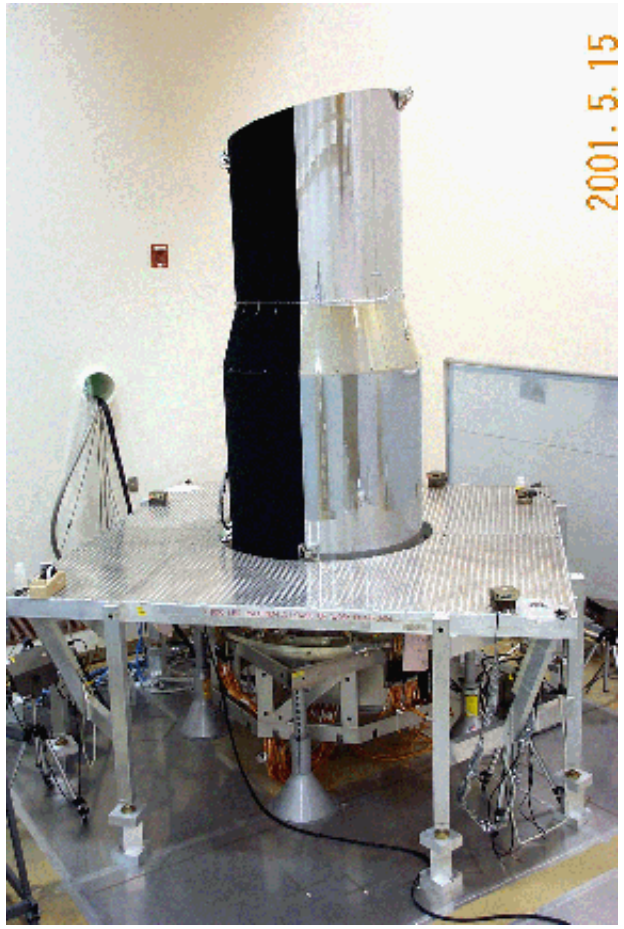


Education & Public Outreach

SIRTF Family Portrait

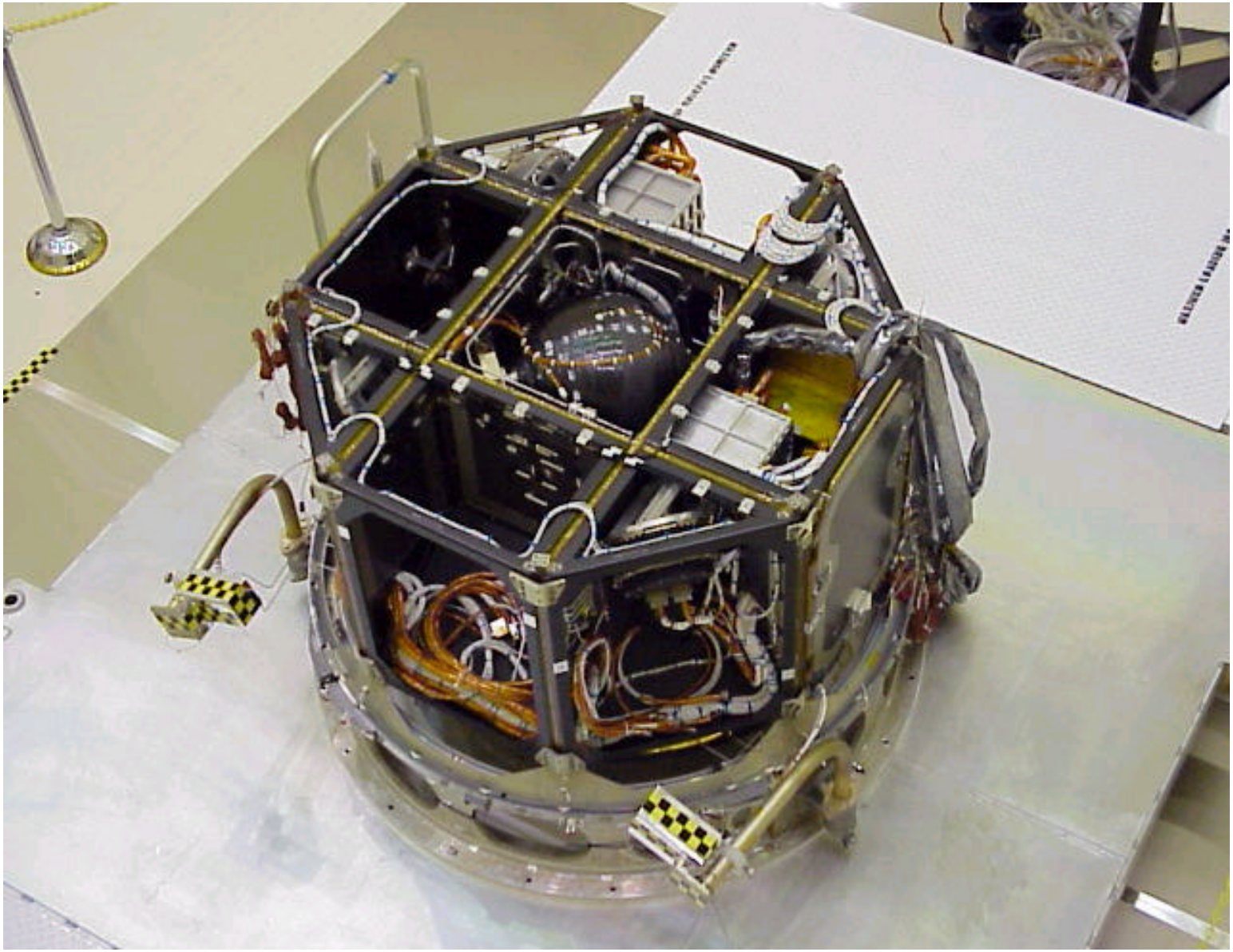


Completing the CTA



Packing up the CTA at Ball

Completed Spacecraft - Includes RCS



CTA Arrives at Lockheed

Status Summary

- **Optical/thermal/cryogenic performance of now-completed CTA appear excellent**
  - *No evidence of degradation due to cryostat overpressurization*
- **Performance of instruments within CTA is consistent with that needed on-orbit**
  - *Expected science return is therefore very exciting, even though each instrument has a performance issue*
  - *The instruments meet their Level 1 requirements*
- **Spacecraft hardware completed; software supporting S/C testing**
- **With Headquarters agreement we are proceeding with revised plan**
  - *Launch slipped from July 15, 2002 to January 9, 2003*
- **Main cause of slip were:**
  - *Delays in completion of spacecraft hardware and software, with consequent delays in operations system development and test*
  - *Need for repeat of complex thermal vacuum test of Cryogenic Telescope Assembly*
- **Scientific promise of SIRTF is within reach**
  - *Team is committed to hard work required to meet challenge of new launch date*
  - *Next major milestone is integration of CTA and Spacecraft, set for February 26*

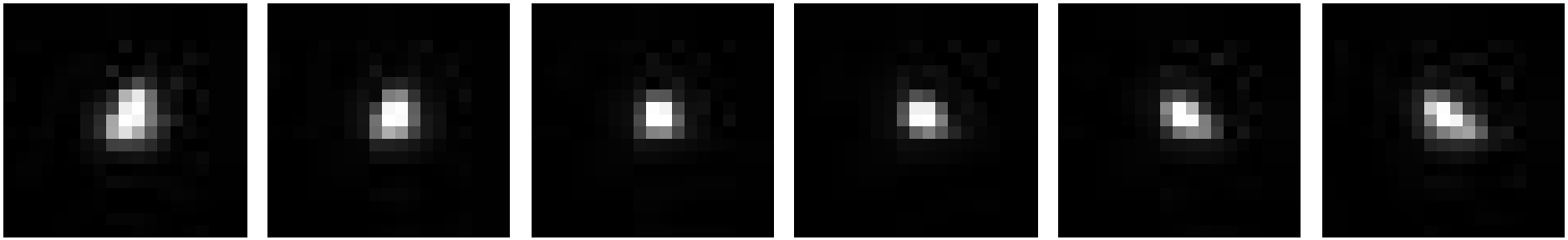
CTA – Cryogenic Telescope Assembly (Ball)

- **Assembled CTA includes cryostat, instruments, telescope and thermal shields**
- **CTA cold testing in Brutus chamber at Ball has been completed**
- **Optical performance: image quality, confocality, agreement with models, focus control – are excellent with telescope at operating temperature**
- **Thermal performance test complex due to difficulty of duplicating on orbit environment**
  - *Thermal couplings within flight system agree with expectations, consistent with 2.5-to-5 yr lifetime*
  - *No evidence of excess heat load directly on helium*
  - *Unexplained heat load on cryostat outer shell of <~20 mw probably due to GSE*
    - In unlikely event that this is present on orbit, operational mitigations still allow lifetime in excess of 2.5 yr
- **CTA has been delivered to Lockheed in time for integration with spacecraft on Feb. 26.**

Instrument Performance Issues

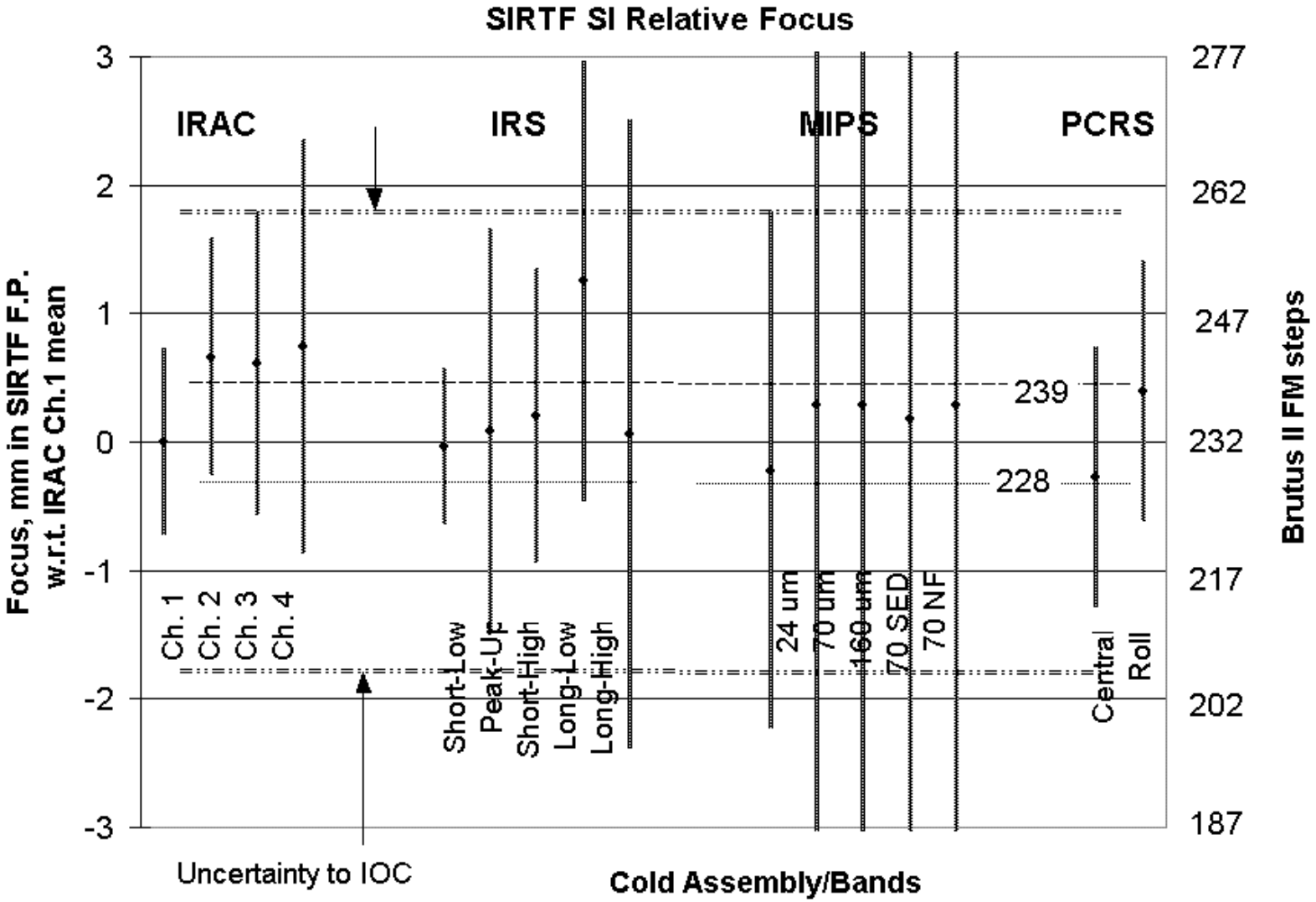
- **IRS: Long Lo order-sorting filter [20-40um] showed signs of delamination in previous cold-cycling; transmission has reduced to ~60-to-70% of initial value**
  - *To be used as is – showed little change during vibe test*
  - *There is low-to-moderate risk of further degradation during launch; long-hi module provides back-up for brighter sources, but science impact of loss of long-lo module would be severe*
- **IRAC: Shutter to be used for darks/flats during on-orbit calibration was found to have potential single-point failure mode which could disable instrument on orbit**
  - *Shutterless operations is now the baseline; new calibration methodology is being developed*
  - *Efficiency may be reduced at start of mission as in-orbit approach is optimized; known stability of arrays suggests overall impact to efficiency and performance will be small*
- **MIPS: Wiring anomaly recently discovered within cryostat**
  - *A 4x8 pixel section of 32x32 70um array is directly impacted by an 18k-ohm short of multiplexer output to ground*
  - *In worst case, failure could propagate and lead to increased noise on entire 16x32 half of the array with severe scientific consequences*
  - *Decision has been made [as for IRS filter] not to incur risk/cost/delay of warming cryostat to repair this problem; instead, efforts focused on understanding and reducing risk of propagation. NASA HQ has accepted this strategy*
  - *Initial results from risk reduction study look promising; status should be much clearer following Observatory EMI/EMC testing in early April*
- **Four other intermittent wires [two each in IRAC and MIPS] appear to have been repaired**
  - *Thousands of wires have survived many thermal cycles; no evidence of generic or systemic wiring problem*

Focus sweep observed with 3.6um IRAC Band 1 array



- Image scale – one pixel = 1.2 arcsec
- No image processing or deconvolution has been done
- Images are double-passed through telescope in Brutus test, and source is off-axis
- Successive images differ in axial focus position by ~0.9 mm
- System requirement is diffraction-limited at 6.5um, FWHM = 1.6”
- Detailed analysis shows this requirement exceeded at best-focus position

Confocality Confirmed



Brutus II Focus Results vs. Alignment Data – (Thanks to J.Schwenker, Ball Aerospace)

- **The previous chart summarizes the result of a "Focus team" which has been working on setting the SIRTF focus prior to launch:**
  - *Vertical bars are centered at pre-Brutus metrology position for each array or module, extent of bar is depth of focus*
    - Only IRAC bands 1,2,3, IRS short-lo module and PCRS can be used in Brutus
    - Brutus results consistent with metrology for IRAC [bands 2 and 3 coincide, band 1 is at a slightly different focus]
  - *Horizontal line at focus step position 239 is team's recommendation for collective best focus for IRAC; focus step position 228 is recommendation for IRS short-lo*
    - One focus step = 65um image motion in Brutus configuration
  - *Axial position of best focus must be changed by ~13mm at SIRTF focal plane to assure that telescope will be in focus following launch, cooldown, and gravity release*
    - Change due largely to curvature of cryogenic "flat". The uncertainty in this change is about +/- 2 mm – [3-sigma] as is shown by dot-dash lines in figure
    - Recommended and followed strategy was to target focus move at IRAC focus (#239)
    - This move has been made and confirmed, but uncertainty requires that we be prepared to adjust focus on orbit. Focus team will continue to work to develop strategy for this adjustment
  - *Bottom Line: Images and confocality look excellent; optical behavior is well-understood and well documented. On-orbit performance **may** be better than current models predict*

Spacecraft (Lockheed)

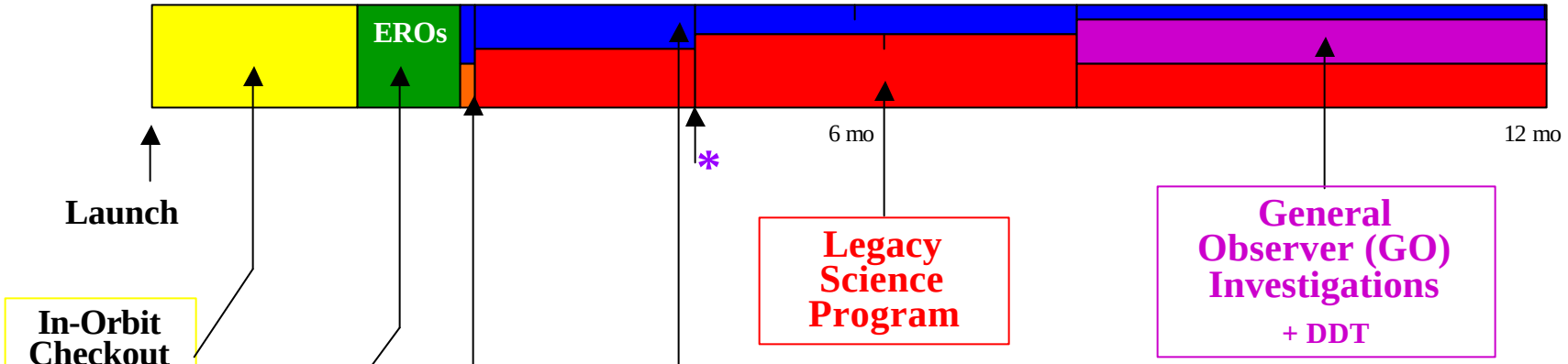
- **Poor schedule performance of Lockheed-Martin spacecraft team was major contributor to recent launch slip**
  - *Spacecraft hardware now complete*
- **Major issue has been slow pace of Flight Software completion at Sunnyvale**
  - *Flight Software is needed for test labs, operations development, ground testing, and flight, so entire project has been held up*
  - *Progress has been very slow despite numerous changes in personnel and approach*
  - *Completion of Reaction Control System has also impacted schedule*
- **Recent changes in leadership and strong intervention by rest of SIRTF team appear have led to turnaround in flight software and progress in testing**
  - *Completed Flight Software is operational on spacecraft for functional test*
  - *This version of Flight Software has been approved for formal qualification testing*
  - *First end-to-end tests of data flow through entire system have been completed using test labs at Lockheed*
  - *Testing has been strongly supported by SSC and by reinvigorated JPL Flight Operations Team*
  - *Continuing progress and success in this area is critical if we are to make the January, 2003 launch*

Science-Related Activities

- **Jay Frogel to become Program Scientist in March**
- **GTOs, Legacy Teams providing SSC with science program updates**
  - *One full year of observations now in data base; GTOs have prioritized targets*
  - *SSC using data base to exercise scheduling tools*
- **Development of science planning and science pipeline tools on track at SSC**
- **Plan for Early Release Observations has been formulated and begun**
  - *Target selection to be complete ~ 1 August*
- **Naming contest in progress**
  - *About 7000 entries*
  - *Committee including science journalists, educators to make recommendation to NASA in June time frame*
- **First three SIRTF Fellows selected from ~60 applicants**
- **Cycle 1 General Observer call to be released in November**
  - *Proposals due in June 2003; planning has begun at SSC*
  - *Proposal ingest system to be tested in ERO process*
- **Plans for In Orbit Checkout and Science Verification completed**
  - *Focus shifted to implementation of plan*
  - *Plan permits first GO call to respond to on-orbit realities*

SIRTF Science: Year One

Substantial Progress Made in Planning Year One



* Cycle 1 Proposals Due